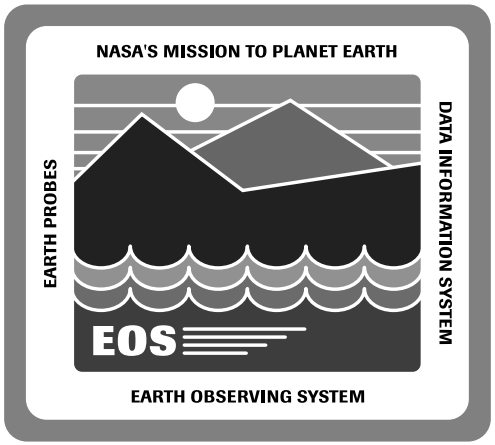


FOS Engineering Activities

Andy Miller

16 October 1995

FOS CDR Roadmap

FOS CDR Overview
- FOS CDR goals
- Driving requirements

System Architecture
- Overview
- Features

IST
- Capabilities
- Plans

Hardware Design
- Computers
- Peripherals

Network Design
- EOC LAN
- IST Connectivity

FOS Infrastructure
- Mgt Services
- Comm Services

Segment Scenarios
- End-to-End Flow
- Subsystem Interfaces
- Building block linkage

Subsystem Design
- Detailed design
- FOS functions/tools
- Subsystem design features

RMA
- RMA allocation
- FMEA/CIL

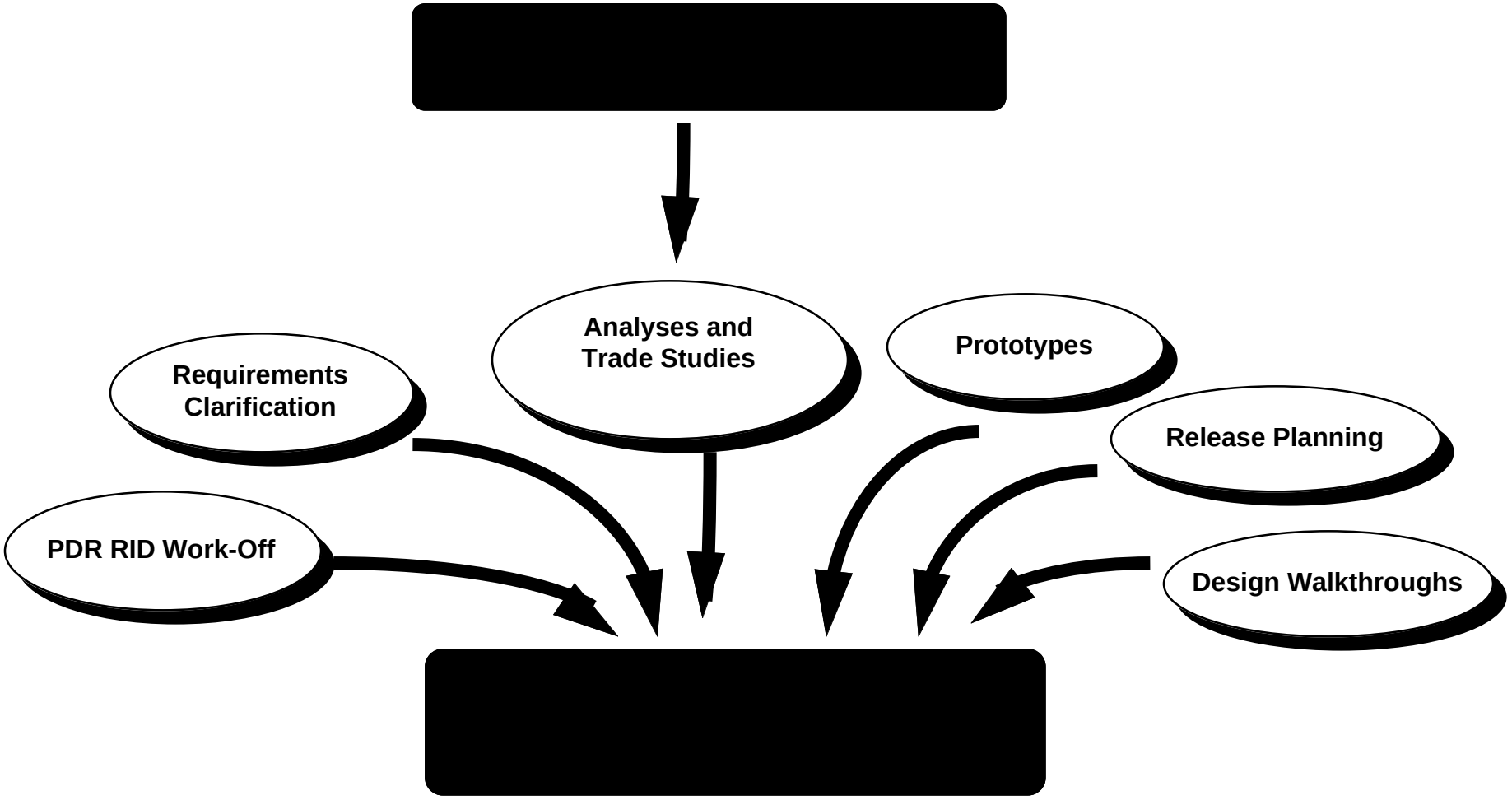
Operations Overview
- EOC facilities
- FOT positions

Operational Scenarios
- End-to-end flow
- Operations perspective
- FOT tool usage

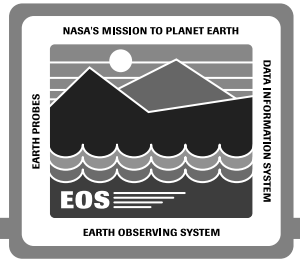
Development
- Release Plan
- Development approach

Testing
- Test approach
- Test organization

FOS Segment Engineering



FOS Changes Since PDR



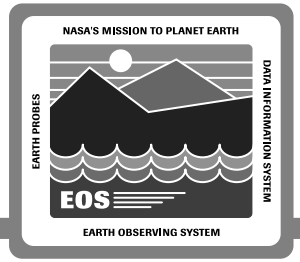
Physical Architecture

- **EOC router and EBnet router interface modified**
  - **Provided to both the Operational LAN and the Support LAN**
- **Multicast Server Added**
  - **ISTs may not be able to receive multicast packets**

    Dependent on the campus network routers
  - **Provides point-to-point reflector from EOC to ISTs for multicast data**
  - **Ensures that I/O performance on EOC servers is not impacted**

    Dedicated host efficiently routes multicast packets to ISTs
- **NSI provides network connectivity between EOC and ISTs**
  - **FOS working closely with ESDIS and instrument teams to ensure system solution is provided**
  - **Awaiting commitment from NSI re: network performance requirements**

FOS Changes Since PDR



Recent Configuration Change Request

- **PLOP-1 and PLOP-2 (Physical Layer Operations Procedure)**
  - **FOS performs processing of PLOP-1 and PLOP-2 instead of EDOS**

    FOS adds acquisition sequence and ground header to CLTU to form command block
  - **Provides more efficient system solution**

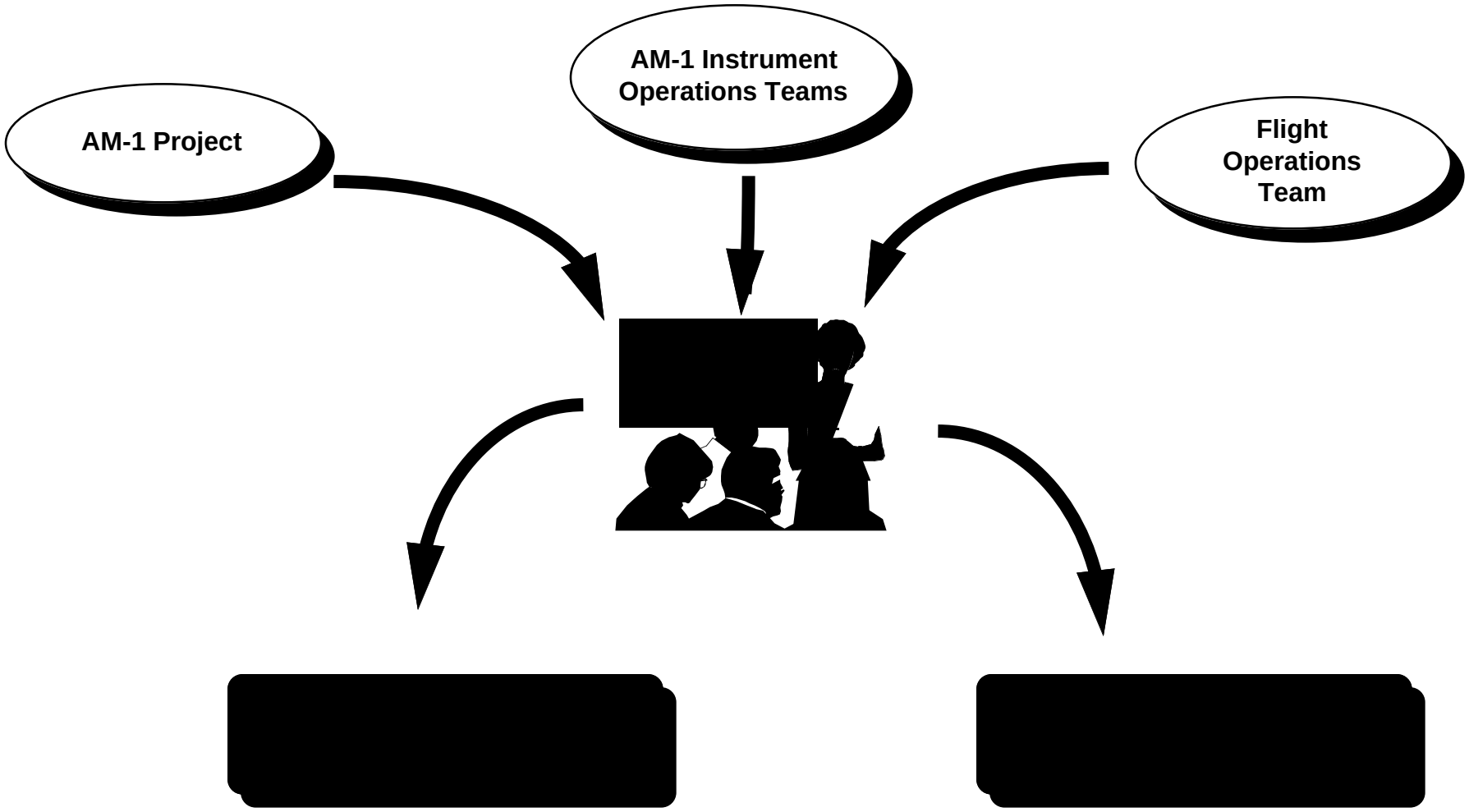
    Provides EOC more control of the uplink

    Simplifies interface testing

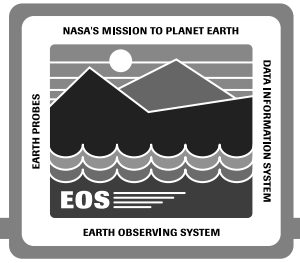
ISTs Added to Efficiently Support FOS External Interfaces

- **SDF and sustaining engineering (LMC, Valley Forge)**
- **ASTER**
- **FDF**

FOS/User Community Collaboration



FOS/User Community Collaboration



AM-1 Project

- **Requirements review process**
  - **Joint AM-1/FOS team analyzed AM-1 Ground System Requirement Document (GSRD) and FOS requirements**
  - **Series of meetings held between January and June to develop common understanding of how FOS addresses AM-1 spacecraft and instrument ground requirements**
- **Requirements review summary**
  - **400 AM-1 GSRD requirements mapped directly to L4 requirements**
  - **33 new Level 4 requirements added based on GSRD discussions**

    Added requirements based on discussions with FOT: e.g., provide capability for FOT to override prerequisite state check failure
  - **GSRD requirements outside current FOS baseline are handled through CCR process**
  - **Facility requirements - traced through the EOC Facility Plan**

FOS/User Community Collaboration

Instrument Operations Team

- **Instrument Advocates**
  - **Objectives**

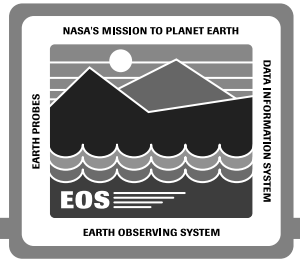
    Provide an FOS team point-of-contact for the instrument teams

    Facilitate the flow of information between the FOS team and the IOTs
  - **Meetings**

    Prototype demonstrations and distributions (ASTER, CERES, MISR, MODIS, MOPITT)
  - **Demo, technical exchange with AIRS, CERES, MISR, MODIS, MOPITT**

    Presentations, technical exchanges with ASTER (Flagstaff, ASTER PDR)

FOS/User Community Collaboration



Instrument Operations Team (cont.,)

- **New requirements (examples)**
  - **Handle redundant CERES housekeeping telemetry**
  - **Calculate the command parameter for the # of scans based on predicted times of sunrise and sunset while generating CERES stored commands**

FOS/User Community Collaboration

AM-1 Instrument Operations Workshop

- **Meeting: February 1995**
- **Objectives**
  - **Summary of open AM-1/FOS requirements issues**

    Instrument teams responded to FOS requirements questionnaire
  - **FOT presented FOT and IOT roles**
  - **AM-1 instrument teams presented how they will operate and monitor their instruments**
- **Results**
  - **Common understanding of requirements status**
  - **Additional insight re: FOS tools and how they can be used**

FOS/User Community Collaboration

AM-1 Instrument Operations Workshop

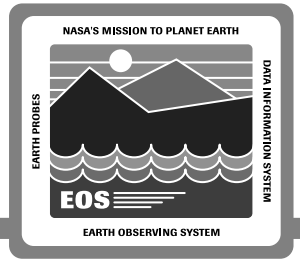
- **Meeting: August 1995**
- **Objectives**
  - **Provide key FOS changes since PDR**
  - **FOS present approach for:**
    - **Delivery of IST software toolkit and updates**
    - **Configuration Management/ File Management capabilities**
    - **IOT Training**
  - **Distribute FOS screen mockups and summary table of FOS Reports**
    - **Solicited and received feedback from IOTs**
- **Results**
  - **Common understanding of IST software CM and IST file capabilities**
  - **Discussion and approach to IOT, FOT, and FOS communications in upcoming project phases**

FOS/User Community Collaboration

Flight Operations Team

- **Integrated effort between FOT and FOS development team during detailed design phase**
  - **FOT developed operational scenarios that describe how FOT will use FOS to perform ground operations**
  - **FOS development team actively supported the development and walkthroughs of the operational scenarios**
  - **FOT team actively supported the detailed design walkthroughs presented by the developers**

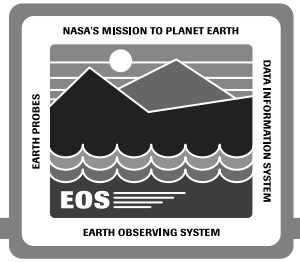
FOS/User Community Collaboration



Flight Operations Team (cont.,)

- **Requirements and design were refined based on FOTs inputs**
  - **Requirements (examples)**
    - **Replay of NCC ODMs and EDOS CODAs**
    - **User defined algorithms**
    - **Custom defined reports**
  - **Design (examples)**
    - **Trigger to initiate plots after back-orbit telemetry has been ingested**
    - **Solid State Recorder Management design**
    - **Spacecraft Activity Log Management design**
    - **Integrated Load Manager tool**

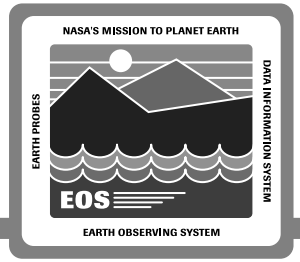
FOS Analyses and Trades



Multicast

- **CSMS determined technical approach to provide FOS multicast solution**
- **Multicast solutions evaluated**
  - **IGMP, RMP, and ISIS**
- **Multicast approach - IGMP**
  - **Provides appropriate technical solution**
  - **Common interface for multicasting with EDOS**
  - **Low cost**
- **Multicast Server analysis**
  - **Provide multicast capability within EOC and point-to-point communication to ISTs**
  - **Ensures that I/O performance on EOC servers is not impacted**

FOS Analyses and Trades



Hardware Vendor Selection

- **Determined vendor that provides best solution for EOC servers and workstations**

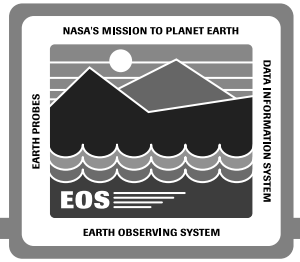
Performance Analysis

- **Network**
  - **Determined appropriate network architecture to support multiple missions**
- **Real-Time**
  - **Determined ability to distribute telemetry processing to User Stations and ISTs**
- **FMEA and Critical Items List analysis**

Security

- **Provide end-to-end security design encompassing internal EOC security and remote IST users**

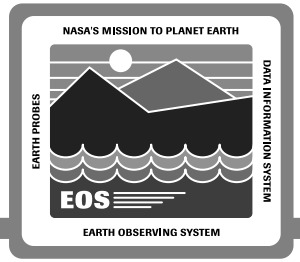
FOS Analyses and Trades



Interfaces

- **Evaluated the use of the ECS IST as the EOC interface with ASTER**
- **Defined the context in which the FOS will use the SCDO Management Subsystem (MSS) and Communication Subsystem (CSS) services**
- **Provided formats to FDF for each of the FDF products that will be provided to the EOC**
- **Supported redefinition of EDOS interface**

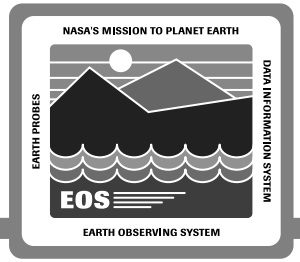
FOS Analyses and Trades



Scheduling Architecture

- **Determined approach for distributing scheduling functions between the FOT/IOT users**
  - **Single resource model**
  - **Single master resource model, multiple slaves**
  - **Multiple resource models**
    - **All resource models obtain data from the database**
    - **Based on heritage design with 60-100 users**

FOS Analyses and Trades



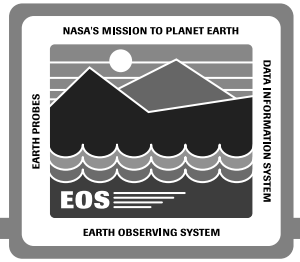
Analysis Request Manager Design Trade

- **Provide FOT visibility into the Analysis request jobs in the system**
- **Enable FOT to efficiently manage Analysis request jobs**
- **Provide ability to utilize EOC hardware resources that are not being fully utilized**
  - **Analysis Farm: analysis request jobs distributed to available EOC hardware resources**
  - **FOT controls identification of EOC hardware resource that can be used in this pool**

Development Tools

- **Evaluated development tools to ensure FOS team is fully prepared for development phase (e.g., ClearCase)**

FOS Analyses and Trades



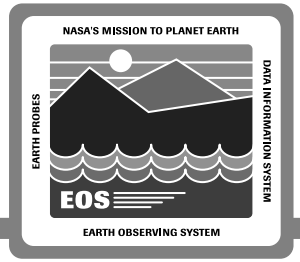
Reuse

- **Determined suitability of other NASA control center software and concepts**
  - **Adapted architecture and design from TPOCC and FOS heritage systems**

    Real-Time Contact Management subsystem designed adapted from TPOCC NCC real-time interface design
- **Determined common software to share with Control Center Technology Interchange (CCTI) group**
  - **User Interface software reuse (event analyzer, room builder, dynamic page)**
  - **Cross-project group provides good check-and-balance re: ensuring design for reuse**

    CCTI projects: HST, MocStation, GlobalStar
- **Evaluated UPS and FORMATS for Planning and Scheduling functions**

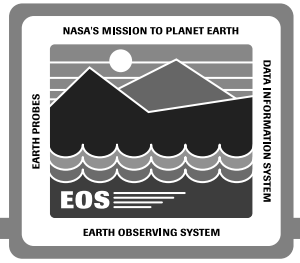
FOS COTS/GOTS



FOS team evaluated COTS/GOTS to optimally use building block components

- RogueWave class libraries
  DCE, KFTP
  HPOpenView
- X Windows system/Motif
  XRT graphs, tables, 3D
  Builder Xcessory
  HTML browser (MOSAIC)
  e-Mail (vendor supplied)
  Report browser editor (PDF)
- SyBase
  Database Xcessory,
  DBTools
- Delphi
  User Planning System (UPS)
- RTWorks
  Altair
  IMSL

FOS COTS/GOTS



FOS team recently reviewed IMACCS and GENIE as control center building blocks

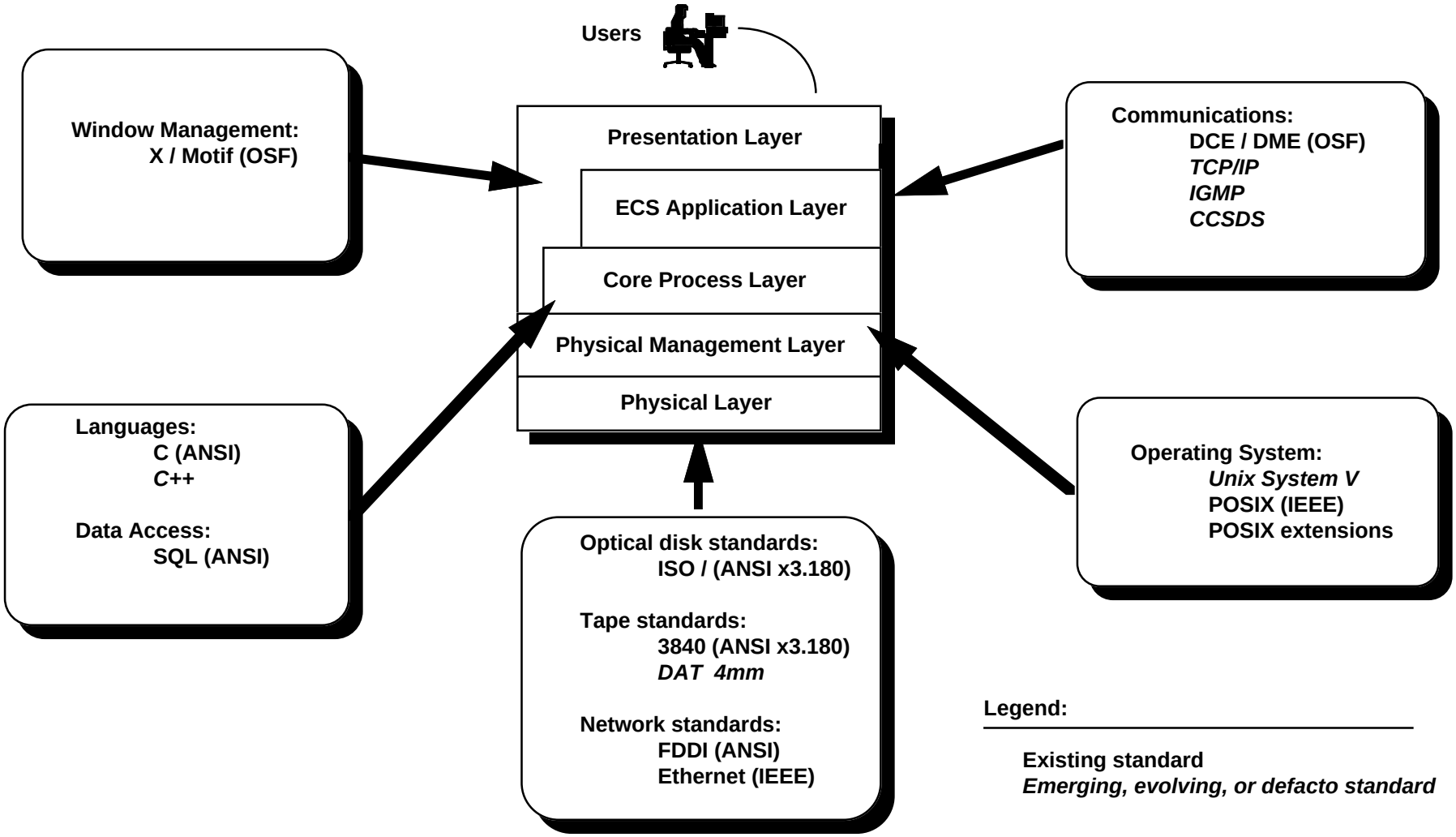
IMACCS - (Integrated Monitoring, Analysis, and Control System)

- **Proof-of-concept control center built from COTS products**
- **Altair provides state recognition engine**
  - **Functions on top of RTWorks**
  - **Complements the procedurally-based RTWorks**
  - **FOS will be using both RTWorks and Altair for Decision Support**

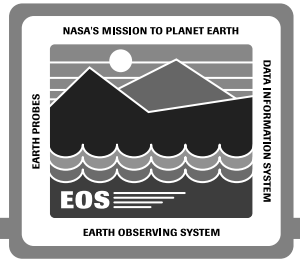
GENIE - (Generic Inferential Executor)

- **Procedurally-oriented script to support contacts autonomously**
- **FOS team reviewed the GENIE system**
  - **Similar conceptually to the FOS Ground Script**
- **Follow-up meetings with the GENIE team have been planned**
  - **Identify lessons learned and potential for collaboration**

FOS Standards



FOS Prototyping

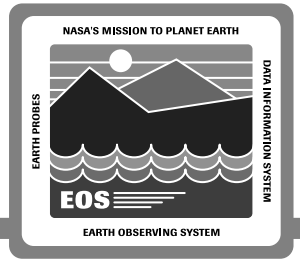


Two Prototype Results Reviews were held for the FOS since PDR

February 1995 PRR

- **Objective**
  - **Develop end-to-end prototypes that integrate threads for Scheduling, Real-Time, and Off-Line functions**
- **Results**
  - **Provide demonstrations to the FOS user community that demonstrate end-to-end prototypes**
  - **FOS integrated CSMS MSS functions into the end-to-end prototype**

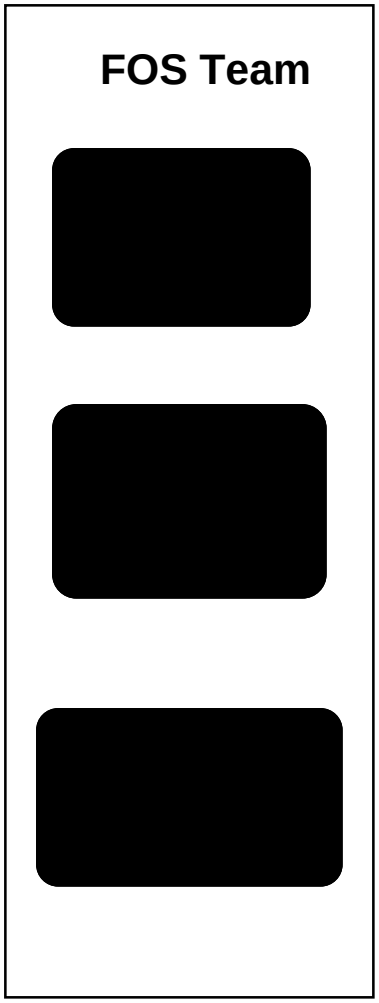
FOS Prototyping



August 1995 PRR

- **Objective**
  - **Perform studies and analyses to drive out the FOS detailed design**
  - **Solve specific design issues through proof-of-concept prototypes**
- **Results**
  - **Selected a series of COTS for the FOS (e.g., SyBase, XRT graphs, IMSL)**
  - **Each subsystem solved a series of specific prototyping objectives (e.g., Planning and Scheduling refined Data Distributor architecture)**

FOS Detailed Design Process



Walkthroughs:
Operations Scenarios
Products:
Operations Scenario Document
CDR Presentation:
Operations Scenarios

Walkthroughs:
Segment Design Models
Products:
FOS Design Spec (Overview, 3.4)
CDR Presentation:
Segment Scenarios

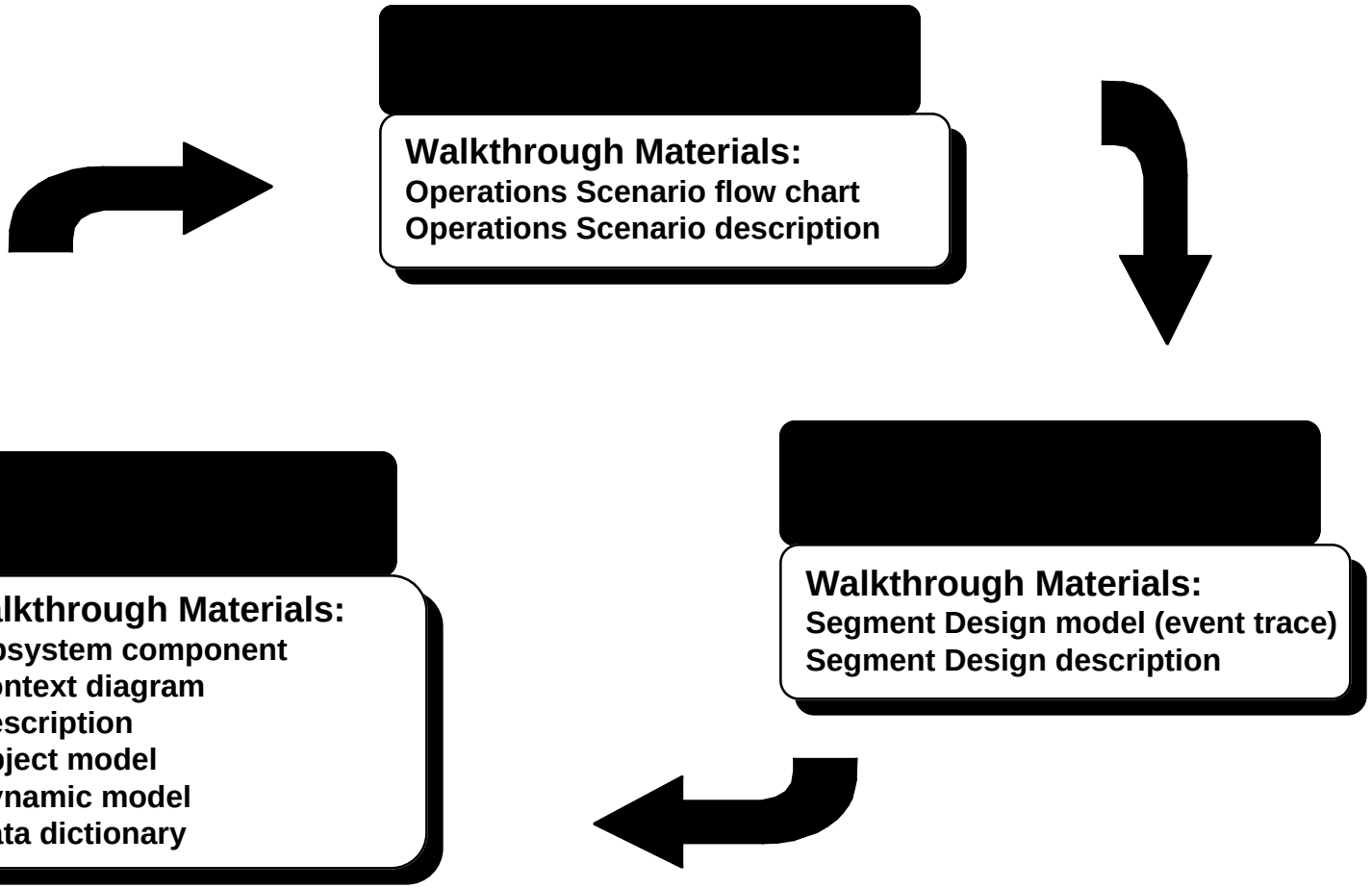
Walkthroughs:
Subsystem Detailed Design
Products:
FOS Design Spec (Books 2-19)
CDR Presentation:
Subsystem Detailed Design

Perspective:
FOT/IOT tool usage
Objective:
Ensure tools provided by FOS are designed for FOT/IOT to efficiently perform their tasks.

Perspective:
Integrate FOS functionality
Objective:
Ensure FOS software design is fully integrated internally and externally;

Perspective:
Define FOS detailed functionality.
Objective:
Ensure detailed design components are completely and thoroughly designed.

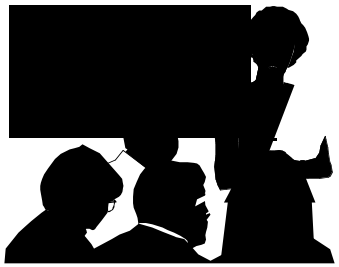
FOS Detailed Design Process



FOS Detailed Design Walkthroughs

NASA FOS

ECS FOT
FOS System Engineers
FOS Developers



Quality Assurance
Test
ECS SI&P

FOS Detailed Design Metrics

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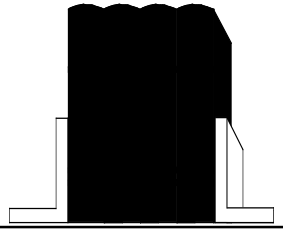
Design Components: 160
Examples: Decom, String Mgr, Analysis Request
Internal I/F Components: 380
Example: Analysis/FUI i/f
External I/F Components: 60
Example: EDOS, NCC, FDF

QA Walkthrough Metrics:
- QA maintained metrics on each FOS walkthrough
- Metrics identified issues and inconsistencies
- All issues and inconsistencies were corrected prior to the delivery of the FOS Design Specification Errors Id and Corrected

FOS Detailed Design Products

FOS Team

- FOS Developers
- ECS System Engineering
- ECS Flight Operations Team
- FOS Integration and Test



FOS Engineering Traceability

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Document and Delivery Date

FOS Requirements Specification
October 1995

FOS Design Specification
October 1995

FOS I&T Plan
October 1995

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